A.D. 1859, 26th JANUARY. N° 235.

SPECIFICATION

OF

WILLIAM RICHMOND ALEXANDER.

MANUFACTURE OF SUGAR FURNACES, AND CONSUMPTION OF SMOKE.

LONDON:
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A.D. 1859, *26th January.* N° 235.

Manufacture of Sugar Furnaces, and Consumption of Smoke.

LETTERS PATENT to William Richmond Alexander, of Glasgow, in the County of Lanark, North Britain, Merchant, for the Invention of "IMPROVEMENTS IN FURNACES AND APPARATUS FOR THE MANUFACTURE OF SUGAR, AND FOR THE CONSUMPTION OR PREVENTION OF SMOKE."

Sealed the 29th April 1859, and dated the 26th January 1859.

PROVISIONAL SPECIFICATION left by the said William Richmond Alexander at the Office of the Commissioners of Patents, with his Petition, on the 26th January 1859.

I, WILLIAM RICHMOND ALEXANDER, of Glasgow, in the County of Lanark, North Britain, Merchant, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN FURNACES AND APPARATUS FOR THE MANUFACTURE OF SUGAR, AND FOR THE CONSUMPTION OR PREVENTION OF SMOKE," to be as follows, that is to say:—

This Invention relates to the arrangement and construction of furnaces and apparatus specially applicable to the manufacture of sugar, and also suitable, to a greater or less extent, for consuming or preventing smoke in furnaces generally. As adapted for the purposes of the sugar manufacture, the arrangement consists of a long "fire mouth" or drying chamber, fitted up immediately in front of the furnace, such fire mouth or drying chamber being formed with a double-bottom, perforated on the upper side for the discharge into the chamber of the heated air. The "megass" or waste sugar cane is deposited in this chamber, and pushed into the furnace from time to time for use through a perforated door, which forms the communication between the drying chamber and the furnace. The furnace bars are tubular, opening at one end into a hollow fire-bridge at the back end of the furnace, and at the other into the false bottom space of the front drying chamber. The grate bars are also minutely perforated on their upper side for the discharge of air amongst the burning fuel upon the bars. Air is forced into the furnace by a blowing fan or other mechanical forcer at the extreme back end of the structure of the furnace. The pipe from the fan conducts the air into and through a set of heating cylinders or chambers studded with lateral spikes or projecting pieces of metal inside and out, to enable the air to take up a superior amount of heat; after leaving this heater, the air is forced along a conducting pipe laid along the bottom of the main flue, and beneath the steam boiler, usually fitted up at the after end of the structures, and beneath the "teaches" or evaporating pans at the front. The air thus takes up heat as it passes along until it is finally discharged into the hollow furnace bridge, whence it passes partly into the furnace directly amongst the burning fuel, and partly through the bars into the space of the false bottom of the drying chamber; the latter portion dries the deposited megass, and then finds its way from the chamber through the perforated division door into the furnace also; in this way the full and efficient supply of highly heated air, subdivided into numerous minute jets, effects the perfect combustion of the fuel, and prevents all or nearly all discharge of smoke. The same arrangement or modifications of it will answer for burning coal and other fuel.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said William Richmond Alexander in the Great Seal Patent Office on the 13th July 1859.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, William Richmond Alexander, of Glasgow, in the County of Lanark, North Britain, Merchant, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Twenty-sixth day of January, in the year of our Lord One thousand eight hundred and fifty-nine, in the twenty-second year of Her reign, did, for Herself, Her heirs and successors, give and grant unto me, the said William Richmond Alexander, Her special license that I, the said William Richmond Alexander, my executors, administrators, and assigns, or such others as I, the said William Richmond Alexander, my executors, administrators, or assigns, should at any time agree with, and no others, from time to time and all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "IMPROVEMENTS IN FURNACES AND APPARATUS FOR THE MANUFACTURE OF SUGAR, AND FOR THE CONSUMPTION OR PREVENTION OF SMOKE," upon the condition (amongst others) that I, the said William Richmond Alexander, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said Letters Patent.

NOW KNOW YE, that I, the said William Richmond Alexander, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement, reference being had to the accompanying Drawings, and to the letters and figures marked thereon, that is to say:—

My said Invention relates to the arrangement and construction of furnaces and apparatus specially applicable to the manufacture of sugar, and also suitable, to a greater or less extent, for consuming or preventing smoke in furnaces generally. As adapted for the purposes of the sugar manufacture, the arrangement consists of a long "fire mouth" or drying chamber, fitted up immediately in front of the furnace, such fire mouth or drying chamber being formed with a double bottom, perforated on the upper side for the discharge into the chamber of heated air. The "megass" or waste sugar cane is deposited in this chamber, and pushed into the furnace from time to time for use through a perforated door, which forms the communication between the drying chamber and the furnace. The furnace bars are tubular, opening at one end into a hollow fire-bridge at the back end of the furnace, and at the other into the false bottom space of the front drying chamber. The grate bars are also minutely perforated on their upper side, for the discharge of air amongst the burning fuel upon the bars. Air is forced into the furnace by a blowing fan or other mechanical forcer at the extreme back end of the structure of the furnace. The pipe from the fan conducts the air into and through a set of heating cylinders or chambers studded with lateral spikes or projecting pieces of metal inside and out, to enable the air to take up a superior amount of heat. After leaving this heater, the air is forced along a conducting pipe laid along the bottom of the main flue, and beneath the steam boiler, usually fitted up at the after end of these structures, and beneath the "teaches" or evaporating pans at the front. The air thus takes up heat as it passes along until it is finally discharged into the hollow furnace bridge, whence it passes partly into the furnace directly amongst the burning fuel, and partly through the bars, into the space of the false bottom of the drying chamber; the latter portion dries the deposited megass, and then finds its way from the chamber through the perforated division door into the furnace also; in this way the full and efficient supply of highly heated air, subdivided into numerous minute jets, effects the perfect combustion of the fuel, and prevents all or nearly all discharge of smoke. The same arrangement or modifications of it will answer for burning coal and other fuel.

And in order that my said Invention may be properly understood, I shall now proceed to describe the several illustrative Figures on the explanatory Sheets of Drawings, which I have hereunto appended for the purpose of showing certain modifications under which my improvements may be judiciously carried out in practice.

In Sheet 1 of the accompanying Drawings, Figure 1 is a longitudinal sectional elevation of one modification or arrangement of my improvements in furnaces and apparatus for the manufacture of sugar and the consumption or prevention of smoke; Figure 2 is a plan of the arrangement corresponding to Figure 1; and Figure 3 is a transverse section of the drying chambers in which the matters used as fuel are primarily placed. According to the arrangement shown in Sheet 1 of the accompanying Drawings, the apparatus is built in a structure of brickwork A, in which is constructed a flue B, that extends from end to end of the apparatus. Above the flue a series of evaporating pans or "teaches" are placed, which in the accompanying Drawing are numbered 1 to 5. At the front end of the apparatus the flue B opens into a furnace C, the fire-bars D of which are made hollow throughout, the upper surface being finely perforated. The ash-pit E below the bars D is closely shut by means of a door to prevent the admission of air thereto; the chimney F in this Drawing is of the usual construction. The supply of air for the combustion of the fuel in the furnace is forced by means of a blowing fan or air-pump or other mechanical means through the pipe G, into a compartment of the cylindrical heating chamber H, placed in the flue leading to the chimney. In this Drawing the heating chamber is shown as consisting of two cylinders arranged concentrically, the inner one being open from end to end, and the space I between the inner and outer cylinders, which serves as an air-heating chamber, being enclosed at each end with metal plates. The surfaces of the cylinders are studded with spikes or flanges or bosses of metal, which project in a radial direction from both sides of the cylinders, these spikes being thus arranged for the purpose of rapidly absorbing heat from the gaseous products of combustion as it passes to the chimney, and of imparting the heat to the air as it is forced through the air-heating chamber. The air, after passing through the heating chamber I, descends by the pipe J, which branches off laterally, is carried along the whole length of the apparatus, and is discharged at the front extremity of the pipe J into the hollow fire-bridge K, which forms the back part of the furnace C. The fire-bridge K forms a chamber which extends across the furnace, the front part being perforated to allow of the emission directly into the furnace of a portion of the stream of heated air that is forced through the pipe J. The pipe J and the fire-bridge K are made of cast iron, but may be made of fire clay or cast iron or other material, covered or protected from the action of the fire by a covering of fire clay or other fire-resisting material. The other portions of the heated air passes into the hollow fire-bars D, the backward ends of which enter the lower part of the hollow fire-bridge K. The perforations made through the upper part of the fire-bars D permit a portion of the heated air to pass through amongst the fuel lying on the fire-bars, the quantity thus conveyed to the fuel being sufficient to keep it in a state of active combustion.

In the manufacture of sugar the waste cane after the juice has been expressed therefrom, and which is termed "megass," is used as fuel, and in the accompanying Drawing a chamber for drying the megass is shown as arranged for use in conjunction with my improvements; this portion of the apparatus consists of a drying chamber L, made of cast iron or other material; the chamber is of a rectangular figure, and is divided into three oblong chambers by the vertical partitions M, as shown in the plan, Figure 2, and the transverse section of the chamber, Figure 3. The front ends of these several chambers are closed by means of the doors N, which afford access to the interior of each chamber for the purpose of filling it with megass, or discharging the same into the furnace. The bottom of the drying chamber L inclines downwards to the level of the fire-bars D, the front ends of which enter the lower part of the chamber L, so that that portion of the heated air which does not pass into the furnace is carried into the chamber L, and serves to dry the megass. The fuel to be dried rests upon the perforated diaphragm or false bottom O, which is arranged on a level a little above the furnace bars D. In this manner the space below the false bottom O serves as a chamber for the heated air, which rises and passes through the megass that is placed in the compartments above it. The quantity of air thus admitted to the drying chamber L is regulated by a valvular door, which is moved by the hand lever D^1. The roof of the chamber L is furnished with a short tubular aperture P, which admits of steam that is driven off from the damp megass escaping into the air, or it may be carried into the chimney; this steam or vapour is prevented from entering the furnace C by means of a damper Q, fitted in each compartment of the drying chamber L. The dampers Q are severally connected by means of a shackle and chain to a counterweight Q^1; the chains pass over pulleys, the spindles of which are carried in the framing R. At the backward end of each of the compartments of the drying chamber L is fitted a hanging door S, swinging loosely; these doors are perforated to allow of any combustible gaseous matters escaping into the furnace C, where they become ignited. The dampers Q are only kept down during the preliminary drying of the damp megass, and as the furnace C requires replenishing the charges of dried and highly heated fuel are successively pushed out of each compartment into the furnace. Thus as the fuel in the compartments becomes heated, the inflammable gases escape in minute gets through the perforations in the hanging doors, and, mixed with air, these matters are deflected downwards amongst the highly incandescent fuel in the furnace, when they meet a further supply of heated air discharged in jets from the front of the fire bridge K, fit for immediate and rapid combustion; every particle of inflammable matter is thus instantly flashed into flame, so that no visible smoke escapes from the chimney F, whilst the fuel is economised in the highest degree. The flame arising from the burning fuel in the furnace C passes along the flue B, and is carried to the backward extremity of the apparatus, where the flue diverges laterally, and enters the shaft or chimney F. On its passage through the flue the flame heats the several sugar pans 1 to 5, and also the multitubular boiler V, the steam of which serves to drive the engine. To raise steam in the bolier V, at the commencement of operations fire is lighted in the furnace U, but when the apparatus is in full operation, the heat that flows through the flue B is sufficient to generate steam in the boiler V. A door W is fitted in the brickwork to afford access to the boiler for cleaning the tubes or other purposes, and the damper T serves to control the velocity of the current of flame through the flue. These several parts being, however, in all respects similar to those in ordinary use, it is unnecessary to enter into a more particular description.

In Sheet 2 of the accompanying Drawings my improvements are shown as applied to an ordinary furnace of a steam boiler. Figure 1 on the said Sheet is a longitudinal vertical section of the arrangement; and Figure 2 is an end elevation, partially in section. In this modification the brickwork A in which the boiler B is set, is modified to a very trifling extent from the ordinary arrangement. The furnace doors C, instead of opening at once into the furnace in the usual way, serve to enclose the elongated furnace mouth or coking chamber D. This chamber is made with a perforated false bottom or diaphragm E, on which the fuel rests, the space below the false bottom serving to receive the heated air, in manner similar to the arrangement shown on Sheet 1 of the accompanying Drawings. At the backward end of the chamber D a perforated door F is suspended, swinging freely on its hinges, for the purpose of deflecting downwards and thoroughly mixing the air and gases as they pass into the furnace G, by means of the numerous orifices in the hanging door, as already described. The furnace G is fitted with hollow bars H, which serve to convey the current of heated air to the space below the chamber D. A portion of the heated air is, however, allowed to escape through the perforations made in the upper sides of the bars, this portion of the heated air serving to support the combustion of the fuel lying on the bars. The stream of heated air is conveyed to the furnace and coking chamber by the pipe I, which is carried along the lower part of the flue J. The front extremity of the pipe I enters the hollow bridge K, which extends across the furnace from side to side, and which may be made of metal or fire clay, as already described. The front side of the fire bridge K is perforated, to allow of the escape of a portion of the heated air directly into the furnace through numerous orifices, so as to meet and combine with the gases evolved from the fuel in the body of the furnace G and the coking chambers D. The backward extremity of the pipe I enters the heating chamber L, which in this modification is arranged in a vertical position in the chimney M; the heating chamber consists of concentric cylinders having radially projecting spikes of metal N, arranged in manner similar to the modification shown in Figures 1 and 2 in Sheet 1 of my Drawings. The air for the supply of the furnace is forced by a fan blast or other mechanical means into the pipe O, and passes downwards between the outer and inner cylinders of the heating apparatus, so that, as already described, the caloric from the escaping current of the products of combustion is caught up by means of the radially projecting spikes or flanges, and communicated to the ingoing current of pure air that is being forced downwards. The back part of the flue J is furnished with a damper P, by means of which the size of the aperture of the flue may be increased or diminished as required. The ash-pit Q is closed by a tightly fitting door, to prevent the admission of air in that direction. The quantity of air admitted to the coking chamber D may be regulated by the valvular apparatus R with the handle S.

In Sheet 3 of the accompanying Drawings is shown one mode of adapting my improvements to the boilers of marine engines. Figure 1 on the said Sheet is a front elevation of the boilers of a marine engine; the Figure is drawn partially in section, to show the internal arrangement; the accompanying view, Figure 2, is a longitudinal vertical section corresponding to Figure 1. In this modification of my improvements the boiler B is constructed in the usual manner. The furnace doors C open into the coking chambers D; the bottom of each chamber is perforated for the admission of heated air from the chamber E. The gaseous matters as they are evolved from the heated fuel escape through the perforations in the hanging door F into the furnace G, where they are ignited as they pass over the incandescent fuel. The steam of heated air passes into the chamber E along the hollow bars H; a portion of the air escapes through the perforations in the bars, which portion serves to maintain the combustion of the fuel in the furnace. The full supply of air for the furnaces is conducted by means of the pipes I, through the boiler and flue J, into the hollow fire bridge K, from whence a portion of the air passes through the perforations in front directly into the furnace, and the remaining portion goes through the hollow bars H. The upward extremity of the pipe I enters the heating chamber L, which in this modification consists of duplex concentric cylinders, arranged so that the upward current of the products of combustion flows in two columns, passing through the open ends of the inner cylinder and between the inner and outer cylinders. The ingoing current of pure air is forced by the fan blast or air pump through the supply pipe O, the inner part of which branches out laterally into two pipes, which enter the outer cylindrical heating chamber at opposite sides of the funnel M, as shown in Figure 1 on Sheet 3 of the accompanying Drawings. The air as it is forced into the heating chamber passes upwards between the walls of the outer cylinders and flows through the lateral openings at the upper part into the inner cylinder; it then passes downwards to the pipe I, and is conducted to the furnaces. The ingoing current of air in its passage through the heating chambers thus takes up, as already described, in reference to the other modifications, that amount of caloric which is ordinarily allowed to escape into the atmosphere through the funnel for the purpose of producing a draught. The admission of air through the ash-pit N is prevented by means of the close door P, and, if necessary, the quantity of air admitted to the coking chamber D may be regulated by the valve Q moved by the hand lever R.

In the foregoing description of my Invention I have spoken only of conveying a current of air through the entrance pipes G and O of the several Drawings; but I propose when the nature of the fuel shall render it expedient to convey a jet of steam into the air pipe, and so cause the mingled air and steam to enter the furnace. By this arrangement I provide that the pipes are preserved to a great extent from being burnt, and as the steam escapes through the various orifices into the furnace and amongst the incandescent fuel on the bars at a very high temperature, it will become decomposed into its gaseous elements, and thus assist in maintaining the vivid combustion of the fuel.

Having now described and particularly ascertained the nature of my said Invention, and the manner in which the same is or may be used or carried into effect, I may observe, in conclusion, that I do not confine or restrict myself to the precise details or arrangements which I have had occasion to describe or refer to, as many variations may be made therefrom without deviating from the principles or main features of my Invention; but what I consider to be novel and original, and therefore claim as the Invention secured to me by the herein-before in part recited Letters Patent, is,—

First, the general arrangement and construction of furnaces and the apparatus connected therewith, for the more effective combustion of the fuel and the gaseous products arising therefrom, as herein-before described.

Second, the arrangement and construction of the drying or coking chambers for effectually drying or coking fuel preparatory to introducing it in a highly heated state into the furnace, as herein-before described.

Third, the application and use of a damper or valvular apparatus in each drying chamber, for the purpose of preventing the admission of steam or aqueous vapour into the furnace from the fresh charges of "megass," as herein-before described.

Fourth, the application and use of the perforated hanging door, fitted to the back extremity of each drying or coking chamber, for the purpose of distributing and mixing the air with the gaseous products arising from the fuel as it becomes heated in the drying or coking chambers, as herein-before described.

Fifth, the system or mode of applying and conveying a current of heated air to the drying or coking chambers, for the purpose of drying the fuel where "megass" or spent or crushed sugar cane is used, and for the purpose of heating and driving off its gaseous elements, and for the purpose of drying or heating coal or other fuel, and driving off the gaseous matters arising therefrom, and conveying them into the furnace, as herein-before described and shown in the accompanying Drawings, or any mere modification of the said arrangement.

Sixth, the arrangement and construction of the hollow furnace bars perforated through their upper surfaces, for the purpose of conveying a current of heated air, or a mingled current of heated air and steam to the fuel in the furnace, so as to promote its active combustion, as herein-before described.

Seventh, the application and use of the hollow fire bridge perforated through its side next the fire, for the purpose of dividing the current of heated air or of air and steam into numerous streams at the part of the apparatus where these streams are brought into contact with the gaseous products of combustion in the furnace, as herein-before described.

Eighth, the system or mode of combining or mingling and using, when expedient, a current of air and steam, the latter being introduced for the purpose of preserving the pipes, and by its decomposition promoting the combustion of the fuel and gases in the furnace, as herein-before described.

Ninth, the arrangement and construction of the heating chamber or apparatus through which the air or air and steam first passes; also the system or mode of abstracting the last portion of heat from the uninflammable gaseous products of combustion before they are allowed to escape through the chimney, so as to utilize as far as possible the heat evolved from the fuel consumed in the furnace, as herein-before described and shown in the accompanying Drawings.

In witness whereof, I, the said William Richmond Alexander, have hereunto set my hand and seal, this Twelfth day of July, One thousand eight hundred and fifty-nine.

W^{M}. R. ALEXANDER. (L.S.)

LONDON:
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Printers to the Queen's most Excellent Majesty. 1859.

A. D. 1859, Jan. 26, No 235.
ALEXANDER'S SPECIFICATION.

(3 SHEETS.)
SHEET 1.

FIG. 1.

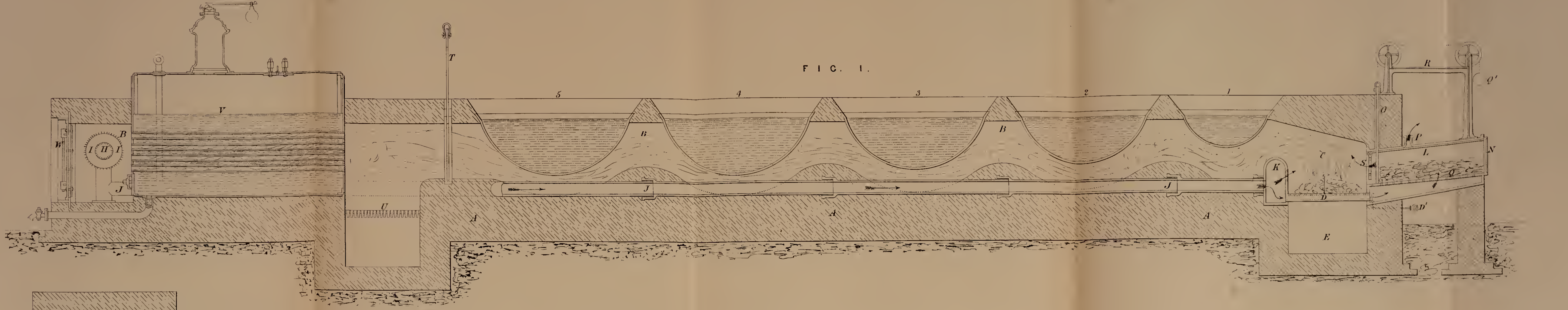


FIG. 3.

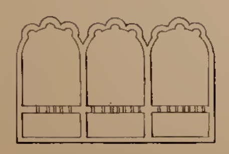
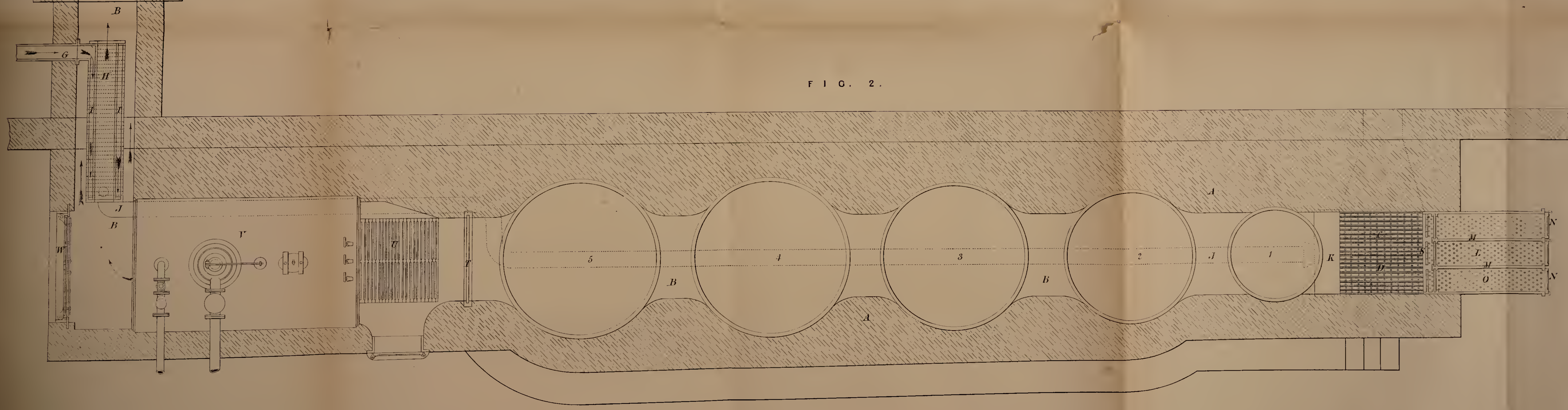


FIG. 2.



SCALE

ins 12 6 0 1 2 3 4 5 10 15 20 25 30 Feet

The filed drawing is colored.

Drawn on Stone by Malby & Sons

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ALEXANDER'S SPECIFICATION.

(3 SHEETS.)
SHEET 2.

Scale, half inch — one foot.

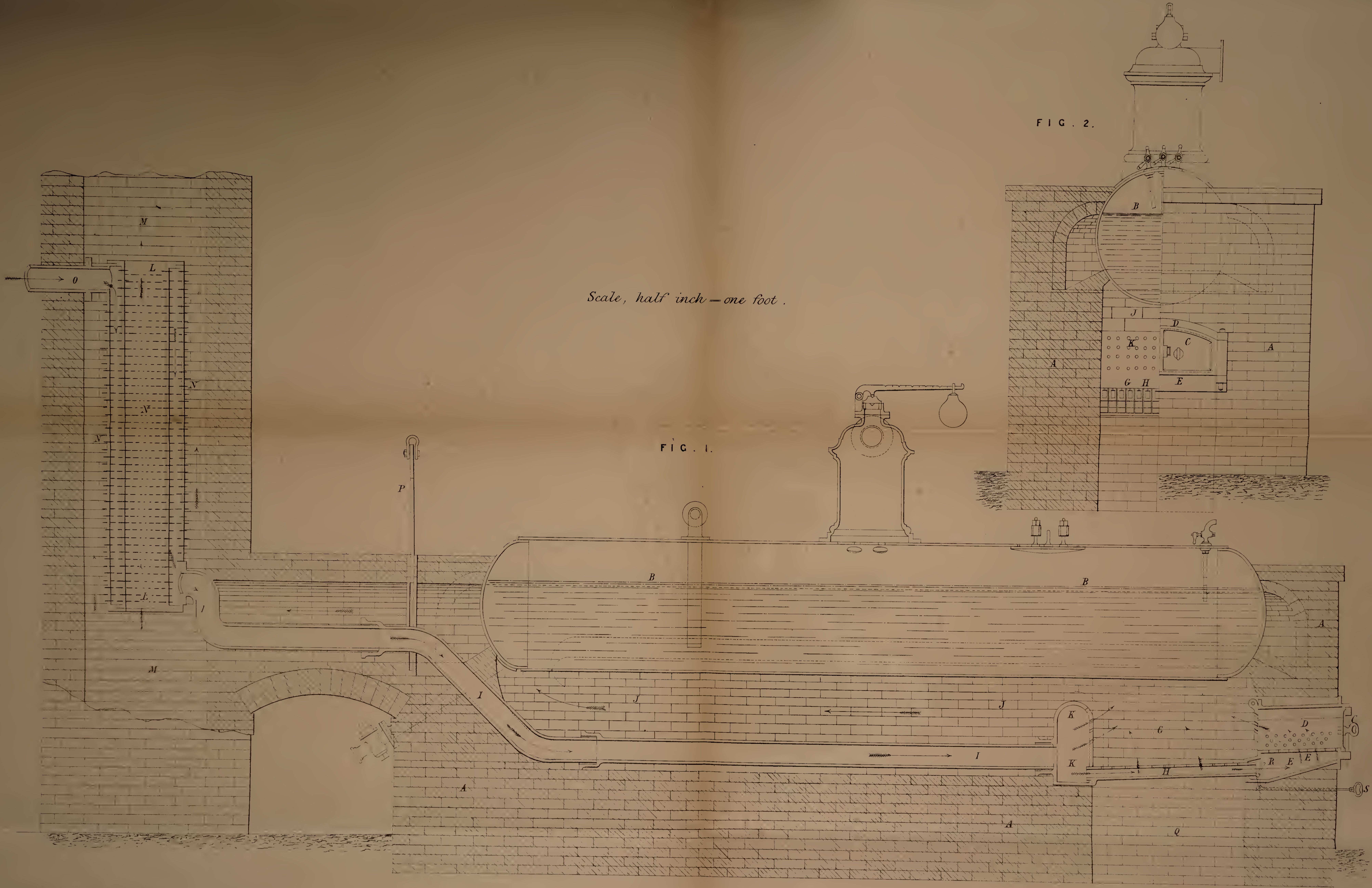

FIG. 2.

FIG. 1.

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(3 SHEETS.)
SHEET 3.

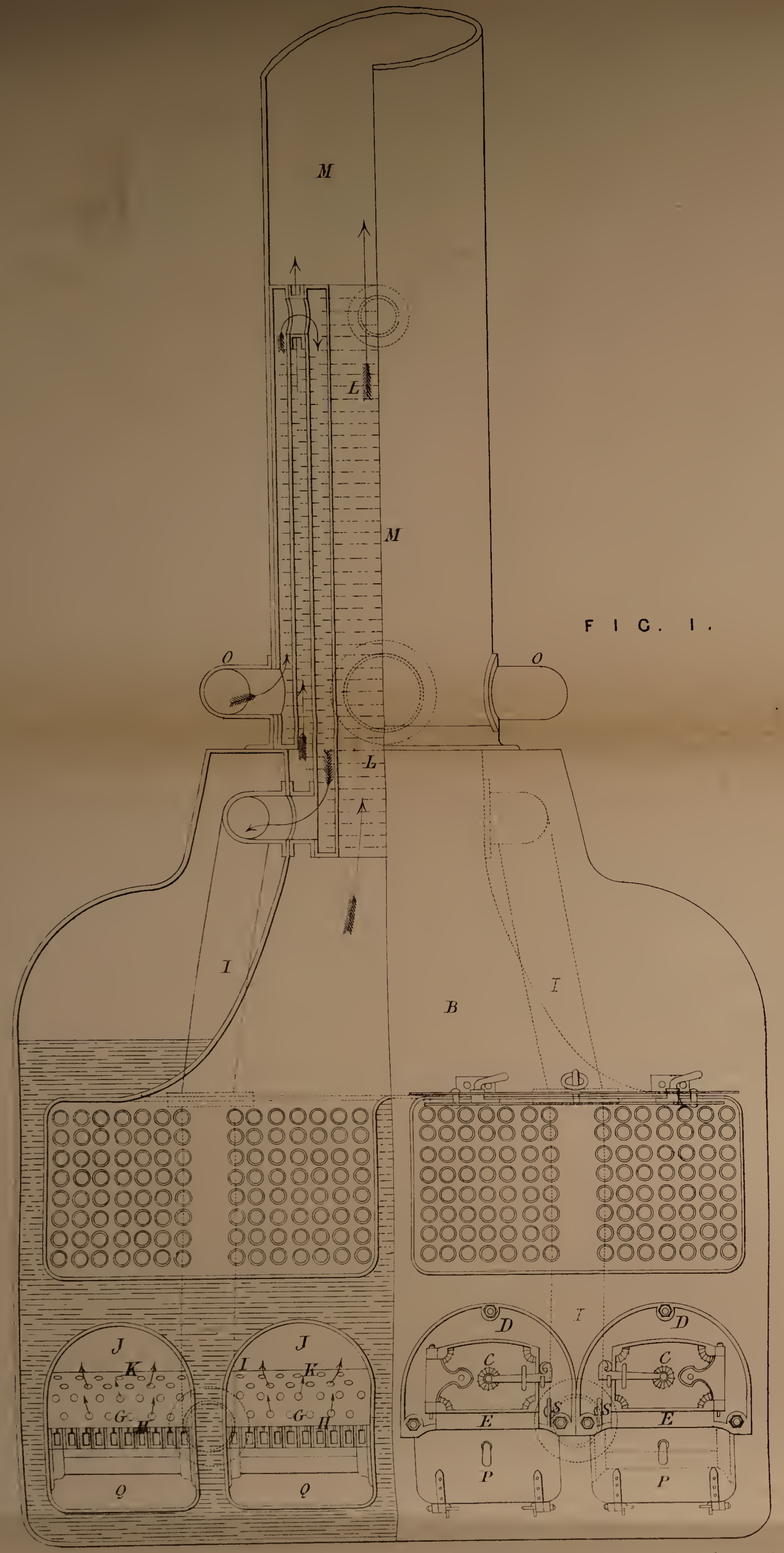
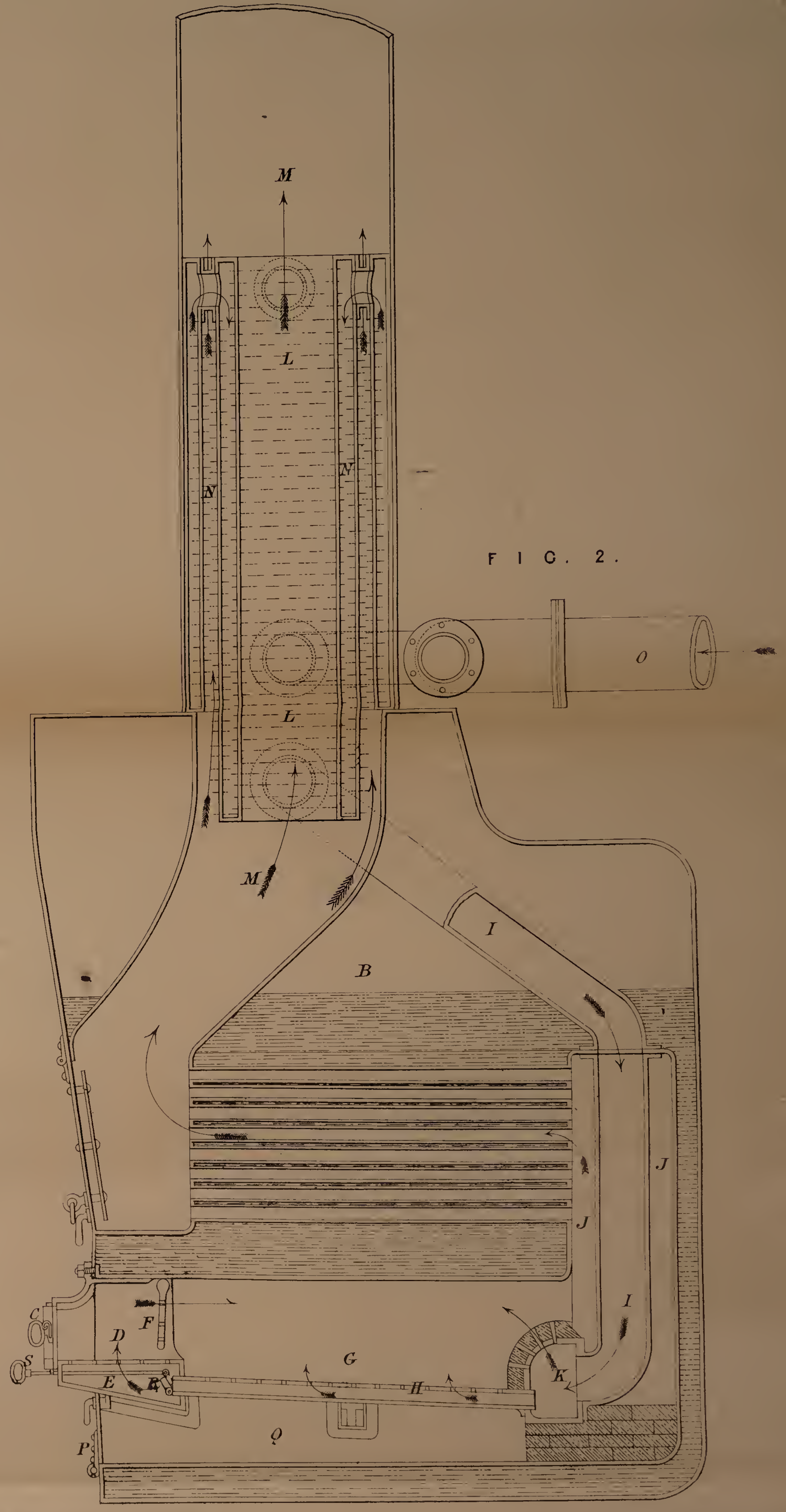


FIG. 1.

FIG. 2.



Scale

ins 12 9 6 3 0 1 2 3 4 5 10 15 20 Feet

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